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A STUDY OF CHEST EXPANSION MEASUREMENT IN HEALTHY ADULTS WITH TWO DIFFERENT INSTRUCTIONS

Physiotherapy

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ABSTRACT

BACKGROUND: Chest expansion is simple and quantitative measurement that can be used to determine a baseline respiratory function i.e. chest mobility, respiratory muscle strength and lung function. A simple and inexpensive technique for measuring chest expansion is by using measure tape.

OBJECTIVE: To obtain and compare changes in chest expansion when adopting two different instructions in relation to age and sex.

METHOD: A prospective study was conducted over a period of 1 year. Chest expansion measurement of 280 subjects was done by traditional and additional/new instructions.

RESULT: The mean chest expansion value among all the age group was greater with additional/new instruction when compared to the traditional instruction in both the genders. ($p < 0.001$).

CONCLUSION: Study concludes significant difference in mean chest expansion between traditional and new instructions. The verbal instruction during measurement of chest expansion is also important.

KEYWORDS

Chest Expansion, Measure Tape, Instructions.

INTRODUCTION

Breathing is a physiological process in which air is taken inside and expelled out of the lungs. When lungs expands and contracts, it influences the mobility of the chest through the attachment of diaphragm and intercostal muscles.[1]

During general assessment, when the history of the individual leads to doubt of the presence or absence of chest problem, the examination of the chest must be taken into consideration, to determine the nature of the problem so that accurate diagnosis can be made. Chest expansion is one of the important components of chest examination. Chest expansion is defined as chest wall mobility or excursion between a maximum voluntary inspiration and a maximum voluntary expiration.[2] Further the usefulness of a measurement technique is determined by its ability to reflect deviations from the normal. [3]

Various cardio-respiratory, neurological, orthopedic and other conditions affect and alter thoracic mobility, chest expansion & excursion.[1] Chest expansion is found to differ due to factors like gender, height & weight of subjects and advancing age.[4,5] Alteration in chest expansion leads to symptoms such as shortness of breath, fatigue, wheeze, sensation such as tightness of chest, decreased exercise tolerance which in turn hampers the individual's well-being.

There are different tools available in a market to measure chest expansion such as measure tape, chest caliper and various sophisticated measurement instruments for example: respiratory movement measuring instrument, respiratory inductive plethysmography, BREATH, and others.[4,6,7,8] Among chest caliper and other instruments, a simple and inexpensive tool for measurement of chest expansion is measure tape. With measure tape, the circumference of the thorax is measured during maximal inspiration and maximal expiration at specific levels. The levels of measurement commonly used are the axillary level, third/fourth intercostal space and xiphoid process.[6,9] Different techniques of measurement have been described in the literature however instructions, level of measurement sites and equipment vary. While going through the literature, the information regarding change in chest expansion measurement by two different instructions came into notice, which further aroused the interest to explore it.

In clinical practice, the traditional instruction commonly used is "breathe in maximally/breathe out maximally" and it has been noted that an additional instruction actively to increase or decrease the volume of thorax over and above the traditional instruction could possibly lead to changes in chest expansion as patient voluntarily activates the muscle of the rib-cage during measurement. It is well known fact that diverse instructions alter the results during spirometry maneuver also.[6] Therefore, the need to examine chest expansion in relation to age, sex and type of instruction given during assessment was felt.

The purpose of this study was to determine and compare changes in chest expansion while adopting two different instructions in relation to age, sex and instructions.

MATERIALS & METHODS

A prospective observational study was conducted at Dhiraj General Hospital, Vadodara over a period of 1 year. Total 280 subjects were recruited for the study by convenient sampling after obtaining written consent. Chest expansion in cm was used as an outcome.

INCLUSION CRITERIA:

1. Self-declared healthy individuals.
2. Normal range BMI (18.5-24 kg/ m^2).
3. Age group (21-60 years).
4. Both genders.

EXCLUSION CRITERIA:

1. Individuals with cardio-respiratory disease.
2. Individuals with any neurological, orthopaedic or rheumatic conditions which affects the pulmonary function.
3. Individuals with injury or deformity of rib-cage.
4. Individuals who has undergone recent cardiothoracic or abdominal surgery.

Participants were given instructions about the chest expansion technique and given high sitting position on plinth/table in a quiet environment. Chest expansion was assessed by using a measure tape around the circumference of the chest at three levels. The upper thoracic expansion was measured at the level of axilla, for mid thoracic expansion tape was placed at the level of 4th intercostal space/nipple line level and for lower thoracic expansion tape was placed at the level of xiphoid process. Male participants were assessed bare chest and female participants with minimal clothing.

The order of instruction was randomised by tossing a coin. The traditional instruction for measuring chest expansion was "breathe in maximally and breathe out maximally" and additional/new instruction was "breathe in maximally and make yourself as big as possible and breathe out maximally and make yourself as small as possible". Rest period of five minutes was given between two instructions. The test was performed thrice for each instruction at all the three level and best values were used for the analysis.

RESULTS

Out of 280 subjects, 150 (53.58%) were male and 130 (46.42%) were females. The mean age of subjects in study was 39.69 years with maximum age of 60 and minimum age of 21 years. Mean BMI of the subjects was 20.93 kg/m^2.

	N	Minimum	Maximum	Mean	SD
Age (In years)	280	21.00	60.00	39.6857	12.5986
Height (In meters)	280	1.46	1.87	1.6355	.0625
Weight (In kg)	280	54.02	75.00	55.9286	7.1506
BMI (kg/m^2)	280	18.00	28.11	20.9270	1.5696

Table 1: The demographic characteristic of participants

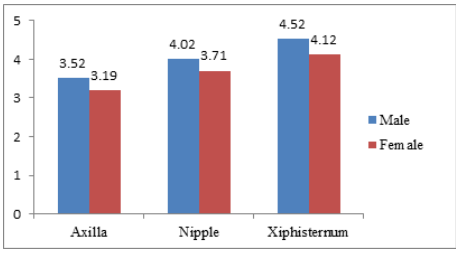

Figure 1: Mean Chest Expansion in male and female (traditional instructions)

The Mean chest expansion by traditional instruction at axilla, nipple and xiphisternum level in males were 3.516 cm, 4.0173 cm and 4.5213 cm while in females were 3.1877 cm, 3.7096 cm and 4.1192 cm respectively. The difference of mean chest expansion at all three anatomical landmarks by traditional instruction in both males and females are statistically significant ($p < 0.05$).

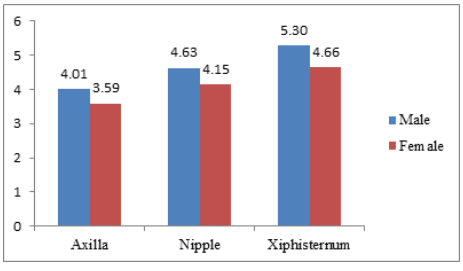

Figure 2: Mean Chest Expansion in male and female (additional/ new instructions)

The Mean chest expansion by additional/new instruction at axilla, nipple and xiphisternum level in males were 4.0087 cm, 4.6327 cm and 5.296 cm while in females were 3.5908 cm, 4.1469 cm and 4.6554 cm respectively. The difference of mean chest expansion at all three anatomical landmarks by additional/new instruction in both males and females are statistically significant ($p < 0.001$).

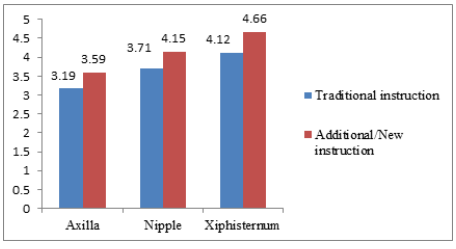

Figure 3: Mean Chest Expansion in females by traditional and additional/new instructions

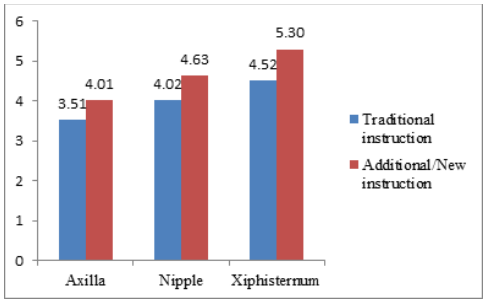

Figure 4: Mean Chest Expansion in males by traditional and additional/new instructions.

The difference of mean chest expansion in male participants at all three levels was statistically significantly higher than female participants ($p<0.001$) in traditional as well as additional/new instructions. (Figure 3 & 4)

The mean chest expansion with additional/new instruction was statistically significantly higher than the traditional instruction in both the genders ($p < 0.001$).

Levels	21-30 years		31-40 years		41-50 years		51-60 years		p value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Axilla	-.5803	.4732	-.3946	.3800	-.4121	.4255	-.4156	.2334	<0.001
Nipple	-.7394	.5153	-.5311	.4860	-.5135	.3450	-.9078	.1972	<0.001
Xiphisternum	-.9747	.6930	-.6460	.4755	-.6090	.4555	-1.266	.2474	<0.001

Table 2: Mean chest expansion between the two instructions in different age groups

Above table shows the mean difference between the two instructions at all the three levels in different age group. The range of mean difference at axilla is 0.39-0.58 cm, 0.51-0.90 cm at nipple and 0.60-1.2 cm at xiphisternum. The mean chest expansion derived from difference between the two instructions was highly significant ($p < 0.001$).

DISCUSSION

Chest expansion measurement is a crucial component in physical examination of cardio-respiratory patients. The extent of chest expansion is considered to be closely related to respiratory function and is considered to be a vital element in signifying pulmonary status.[10]

Study was carried out to determine reference values of chest expansion for healthy adults by adopting two different instructions. The derived mean chest expansion at all three levels was higher in males than females with traditional as well as additional/new instructions ($p < 0.05$).

The mean difference of chest expansion at all three levels by two different instructions were highly significant in both the gender ($p<0.001$) which indicates additional/new instruction leads to greater mean chest expansion values than the traditional instruction as it allows the maximal range of motion in the thorax because of additional voluntary activation of the rib cage muscle i.e. intercostal and other accessory muscles.[6] However, it is not known whether encouragement can further improve the results of the new instruction.[11]

In this study, it was also noticed that the chest expansion declines with advancing age. There was age related differences in the chest expansion both in males and females. In younger age groups mean chest expansion was higher compared to older age group.[12,13] There was statistically significant difference between the age and chest expansion measurement of both the gender. There was negative correlation of age in context to chest expansion measurement ($p<0.001$). There was an initial up-slope in chest expansion in 20-30 year age population then it was followed by a slight decline in chest expansion from 31-50 year of age population due to reduction of FEV1 and FVC every year and from the age of 50 years onwards there is down slope and drastic decrease in chest expansion values due to reduction of lung compliance due to aging process.[4,14] Aging also affects the pulmonary system which leads to changes in bones and muscles of the chest and spine, changes in lung tissue, changes in immune system which leads to changes in pulmonary compliance.[13,15]

The mean chest expansion in males at all three levels was higher than female participants. The difference could be due to females having smaller radial rib cage dimensions in relationship to height than males, a greater inclination of ribs, a comparable diaphragm dome position relative to the spine, and a shorter diaphragm length.16 Therefore, chest expansion in males is greater than the female.[2,3,17]

CONCLUSION

The additional/new instruction is more effective than the traditional instruction for chest expansion measurement. The mean average chest expansion measurement of males is more than females. The verbal instruction during measurement of chest expansion is of importance. This study supports the use of new instruction for the measurement of maximal range of motion of thorax as well as for chest expansion. Thus we concluded that to assess the maximal range of motion in the chest, the patient should be instructed not only to "breathe in/breathe out" but also to "make yourself as big/small as possible".

SCOPE FOR FURTHER STUDY

Study can be conducted using different sophisticated chest expansion measurement instruments.

CONFLICT OF INTEREST

We declare that there were no conflicts of interest in the entire journey of the study.

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